

MONODISPERSE PARTICLES BASED ON COPOLYMERS OF METHYL METHACRYLATE OR STYRENE WITH N-VINYLFORMAMIDE

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Monodisperse polymeric particles with functional groups on their surface are of great interest because their application as carriers for biological active substances in biotechnology and medicine or as structural elements of novel hierarhic materials for optoelectronics and chemisensorics. Particle size, surface structure, and functional group nature are the main factors, which should be regulated during heterophase radical polymerization to meet certain requirements in these fields. However, the introduction of amino groups onto particle surface causes some troubles, since these groups interfere with free radical processes.

N-vinylformamide (VFA) as a functional hydrophilic comonomer gave us a good chance to overcome the problem. In such a case, amino surface groups could appear due to surface hydrolysis of VFA units in acidic media after polymerization. Various techniques of heterophase copolymerization of methyl methacrylate or styrene with VFA were examined to obtain monodisperse particles. Emulsifier-free emulsion (co)polymerization initiated by 2,2'-azobis(2-methylpropionamidin) or 2,2'-azobis[2-(2-imidazolin-2-yl)propane] dihydrochlorides and the process in the presence of dextran or low concentration of cetyltrimethylammonium bromide were applied to ensure both positive charge and hydrophilicity of the particle surface. As a result, a narrow particle size distribution was achieved for particle diameters from 50 nm to the submicron range. After hydrolisis, particle surface layers contained amino groups originated from VFA units along with carboxylic groups from hydrolyzed azoinitiator residues. Their ratio varied with synthetic conditions.

To avoid carboxylic group formation and obtain monodisperse polymeric microspheres up to some microns in diameter, dispersion copolymerization of styrene and VFA was carried out in polar media using polyvynylpirrolidone as a steric stabilizer and azobisisobutyronitrile as an oil-soluble azoinitiator.

Full surface charge of the particles was determined by conductometric titration. Their electrosurface properties were studied by microelectrophoresis in a wide pH range. Some of the particles were tested as bioligand carriers, wherefor chemisorption of model protein, bovine serum albumin, was investigated. Other particle samples were capable of self-assembling from their dispersions into stable 3D ordered structures which demonstrated photonic crystalline features.